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GENERATOR FOR DNEPROVSK HYDROELECTRIC
POWER STATION IMENI V. I. LENIN

Stalin Prize Laureates and Engineers
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 A. S. Yeremeyev, Elektrosila Plant
 imeni S. M. Kirov

Before World War II, hydrogenerators of 77,500 kilovolt-amperes at 88.3 rpm were installed at the Dneprovsk Hydroelectric Power Station imeni V. I. Lenin. Some of them were manufactured by the American firm, General Electric, and others by the Elektrosila Plant.

The German invaders completely destroyed Dneproges, the pride of Soviet power engineering, and damaged all the generators to such an extent that it was not possible to repair them. Therefore, in rebuilding Dneproges, it was decided to manufacture and install new hydrogenerators, and to make these generators more powerful and of better quality than the old ones.

Again the generators were divided between the Elektrosila and General Electric, but the numerical relationship was altered in favor of the Elektrosila Plant, from which most of these machines were ordered.

The construction and installation workers of the Dneprovsk Hydroelectric Station have already fulfilled the yearly plan for newly installed capacity.

At present, there is sufficient experience in the installation, starting, adjusting, and operation of American and Soviet generators to make a comparison between the two.

Soviet and American generators of the same power and other basic parameters, and similar in appearance, differ considerably in design features. The principles on which the design of Soviet generators is based have completely justified

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themselves, and it is now possible to declare with assurance that Soviet hydro-generators are better than the American ones. Moreover, as a result of serious defects and breakdowns which occurred during the installation and operation of the American generators, the station was compelled to replace a most important part in these machines -- the thrust bearings -- with bearings of Soviet design ordered from the Elektrosila Plant. Only after the thrust bearings of the General Electric generators had been replaced did the machines begin to operate satisfactorily.

Main Technical Data of Generator

The main technical data of the generator for Dneproges is as follows: nominal power, 90,000 kilovolt-amperes; 72,000 kilowatts; power factor, 0.8; nominal load efficiency, 97.8 percent; continuous "episodical" power, 103,500 kilovolt-amperes, 83,000 kilowatts; voltage, 13.8 kilovolts (plus or minus 5 percent); stator current, 3,765 amperes; speed, 83.3 rpm; flywheel moment, 39,000 ton-meters squared; runaway speed, 167 rpm; and total load on rotor foot-step, 1,030 tons.

Attention should be drawn to the fact that two power ratings are shown. In practice, the nominal continuous rating is 103,500 kilovolt-amperes. However, under this load the stator winding temperature becomes somewhat excessive, and it is advisable to operate at this rating only when necessary. Ordinarily, it is recommended that the generator be operated at about 90,000 kilovolt-amperes.

Examination of the data given above shows that the hydrogenerator described is among the most powerful machines of this type in the world in both power and geometrical dimensions. The latter are very large due to the comparatively high speed of the machine.

Comparative data on the three largest generators in service, namely, the Dneprovsk (new), Dneprovsk (old), and Shcherbakovka generators, respectively, is as follows: rated capacity (kilovolt-amperes), 103,500, 77,500, and 68,750; rpm, 83.3, 88.3, and 62.5; conventional turning moment (ton-meters), relative to kilovolt-amperes 1,240, 880, and 1,100; external diameter (meters), 13.1, 12.6, and 14.4; total weight (tons), 986, 825, and 1,200; specific expenditure of materials (kilogram/kilovolt-amperes), 9.5, 10.7, and 17.4.

It can be seen that the new machine is the most powerful of these three. Its outside diameter and total weight are only slightly less than those of the Shcherbakovka generator, but the specific expenditure of materials is considerably less than in the other two machines, which is a striking feature of the new generator.

Structural Features

The construction of the new hydrogenerator for Dneproges reflects, to a considerable degree, the requirement for an installation in the old foundation. Fulfillment of this requirement compels the retention of the overhung type of generator characterized by a heavy upper cross head with thrust and guide bearings installed on it.

Generator excitation is provided by a system of direct individual excitation, i.e., by means of an exciter and pilot exciter installed on a common shaft with the generator. Also mounted on the same shaft is a generator with permanent magnets to feed the motor driving the regulator of the hydraulic turbine. The generator has a closed ventilation cycle. The constant volume of air circulating in the ventilation system is cooled by ten air coolers, placed along the outer cylindrical casing of the stator frame. Provision is made for removing the hot

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air to heat the engine room of the station in winter. [Note: detail on the structural features of the stator frame, stator windings, rotor shaft and frame, rotor poles, crossheads, thrust bearing, exciters, and external appearance are available in the original document in CIA. A general view of the generator is also shown.]

Conclusion

It is extremely significant that the Elektrosila Plant produced the new Dneprovsk generator in one third the time required for the old Dneprovsk generator and other generators of comparable size. A number of very effective measures were proposed by the foreman, workers, and Stakhanovites on the plant.

The wide joint planning of operations, the use of several machines for simultaneous machining of parts, etc., enabled the production time for the machines to be shortened considerably and the high quality to be preserved.

Work on these generators has enabled Soviet hydroelectric generator construction to pass to a higher technical level and has prepared this branch of Soviet machine building for the manufacture of new and still more outstanding machines.

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